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Sign Language Recognition Application Systems for Deaf-Mute People: A Review Based on Input-Process-Output

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Abstract

Sign Language Recognition is a breakthrough for helping deaf-mute people and has been researched for many years. Unfortunately, every research has its own limitations and are still unable to be used commercially. Some of the researches have known to be successful for recognizing sign language, but require an expensive cost to be commercialized. Nowadays, researchers have gotten more attention for developing Sign Language Recognition that can be used commercially. Researchers do their researches in various ways. It starts from the data acquisition methods. The data acquisition method varies because of the cost needed for a good device, but cheap method is needed for the Sign Language Recognition System to be commercialized. The methods used in developing Sign Language Recognition are also varied between researchers. Each method has its own strength compare to other methods and researchers are still using different methods in developing their own Sign Language Recognition. Each method also has its own limitations compared to other methods. The aim of this paper is to review the sign language recognition approaches and find the best method that has been used by researchers. Hence other researchers can get more information about the methods used and could develop better Sign Language Application Systems in the future.

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Keywords: sign language recognition; application of sign language; data input; deaf; mute;

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1. Introduction

Deaf is a disability that impair their hearing and make them unable to hear [1], while mute is a disability that impair their speaking and make them unable to speak [2]. Both are only disabled at their hearing and/or speaking, therefore can still do much other things. The only thing that separate them and the normal people is communication. If there is a way for normal people and deaf-mute people to communicate, the deaf-mute people can easily live like a normal person. And the only way for them to communicate is through sign language.

While sign language is very important to deaf-mute people, to communicate both with normal people and with themselves, is still getting little attention from the normal people. We as the normal people, tend to ignore the importance of sign language, unless there are loved ones who are deaf-mute. One of the solution to communicate with the deaf-mute people is by using the services of sign language interpreter. But the usage of sign language interpreter can be costly. Cheap solution is required so that the deaf-mute and normal people can communicate normally.

Therefore, researchers want to find a way for the deaf-mute people so that they can communicate easily with normal person. The breakthrough for this is the Sign Language Recognition System. The system aims to recognize the sign language, and translate it to the local language via text or speech. However, building this system cost very much and are difficult to be applied for daily use. Early researches have known to be successful in Sign Language Recognition System by using data gloves. But, the high cost of the gloves and wearable character make it difficult to be commercialized [3]. Knowing that, researchers then try to develop a pure vision Sign Language Recognition Systems. However, it is also coming with difficulties, especially to precisely track hands movements.

The problems of developing sign language recognition ranges from the image acquisition to the classification process. Researchers are still finding the best method for the image acquisition. Gathering images using camera gives the difficulties of image pre-processing. Meanwhile, using active sensor device can be costly. Classification methods also give researchers some drawbacks. Wide choice of recognition method makes researchers unable to focus on one best method. Choosing one method to be focused on, tends to make other method that may be better suit for Sign Language Recognition, not being tested. Trying out other methods makes researchers barely develops one method to its fullest potentials.

This paper aims to discuss the Sign Language Recognition System that are being used by researchers. In this paper, we will discuss about the Sign Language Recognition form application point of view. This paper will talk about the device used in getting the data, data acquisition, such as data from early researches or self-made data, the recognition method that are recently used by researchers, and the output of previous researches.

2. Data Acquisition

The main device used as input process in Sign Language Recognition (SLR) is camera. The SLR input data is in the form of gesture image that can be easily captured by camera. Some researchers still use simple camera to capture the image. Some researcher argue that they use camera and no gloves to prevent the difficulties when using sensory gloves [4]. Usually, cameras support many video format, so that we need to specify the default format and the format we want to use by using digitizer configuration format (DCF) file [5]. Some researchers also use higher specification camera because the web camera's image is blurred [6]. [7] used camera to capture 30 frames per second real-time video, which was then analyzed for dynamic gestures frame by frame. To extract the skin region, the system used skin filter and then for every frame to image is converted into HSV color space. [8] uses 4 cameras for the data acquisition, -20°, -10°, 10° and 20° position from the center respectively for each camera. In paper [9] also used a webcam through MATLAB for capturing the image and then stored in a directory. Signer must be ready to perform sign language hand gesture before clicking the start button in the application and click the Stop button when the signer is done performing the gesture.

There is also other device named Microsoft Kinect, which is used to capture images. Nowadays, Kinect is widely used by researchers because of its feature. Kinect can provide color video stream and depth video stream simultaneously. With depth data, background segmentation can be done easily. [10], [11], [12] and [3] uses Kinect for Sign Language Recognition. In paper [13] which also used Kinect extracted hand information from skeletal data from 20 joints they are X, and Y position of each joints, wrist, spine, shoulder and hip. (ini citation nya bukan nomor 9, gw gaktau refresh nya gmn). A sample of Kinect video stream is shown in Fig. 1.